

Joint Trauma System



Emergency Life-Saving Cranial Procedures by Non-Neurosurgeons in Deployed Setting

Part of the Joint Trauma System (JTS) Clinical Practice Guideline (CPG) Training Series



Purpose



This CPG applies to military non-neurosurgeons in a forward deployed location with surgical capability (Role 2 surgical teams that meet capability requirements) outside of the United States.

This presentation is based on the JTS Emergency Life-Saving Cranial Procedures by Non-Neurosurgeons in Deployed Setting CPG, 23 Apr 2018 (ID:68). It is a high-level review. Please refer to the complete CPG for detailed instructions. Information contained in this presentation is only a guideline and not a substitute for clinical judgment.

Agenda



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Summary



- Early telemedicine consultation with neurosurgeon is ideal.
- Cranial procedures should only be done under very specific circumstances by non-neurosurgeons and only if a neurosurgeon is not available within 4 hours.

Background



- The standard of care for the treatment of severe traumatic brain injury (TBI) includes direction, evaluation, and treatment by a neurosurgeon.
 - ❑ Neurosurgical assets may not be available for all missions.
 - ❑ Timely evacuation of TBI patients is not always available.
- There is a recognized occasional need for non-neurosurgeons to perform cranial procedures far forward.

Background



Definitions

Craniotomy: The removal of part of the skull for the purposes of accessing contents of the calvarial vault, and then replacing the bone in its original position using plates and screws.

Craniectomy: The removal of portions of the skull for the purposes of accessing the contents of the calvarial vault without replacement of the bone.

Ventriculostomy: The placement of a small catheter within the body of the lateral ventricle through a small burr hole drilled approximately 10-11 cm posterior to the glabella and 2.5-3 cm lateral to midline. This catheter can be used to drain cerebrospinal fluid and to measure intracranial pressure.

Subdural hematoma: The accumulation of blood within the subdural space, usually as a result of trauma, and best diagnosed with a computerized tomography (CT) scan. Some general indications for surgery include hematomas > 1 cm in maximal thickness especially if associated with > 5 mm midline shift on a non-contrast CT of the head.

Epidural hematoma: The accumulation of blood within the epidural space, usually as a result of trauma, and best diagnosed with a CT scan. Common locations include the temporal region (middle cranial fossa) due to laceration of the middle meningeal artery. Some general indications for surgical intervention may include a hematoma > 30 mL in size on non-contrast CT head, especially if associated with evidence of uncal herniation. This can be clinically diagnosed when there is a dilated, unreactive pupil (3rd cranial nerve compression) with contralateral hemiparesis, with or without hemodynamic instability (hypertension, bradycardia, respiratory variation).

Intracerebral hemorrhage: The accumulation of blood within the parenchyma of the brain. This can result from trauma, and is best diagnosed with a CT scan.

Penetrating brain injury: Injury to the brain resulting from penetration of the skull, dura, and brain parenchyma by a foreign body.

Recommendations



A cranial procedure is recommended after teleconsultation with neurosurgery (when possible) and:

- Severe closed supratentorial brain injury with $GCS \leq 8$ AND localizing cortical dysfunction (unilateral pupil or hemiparesis) with:
 - ☐ Accompanied by hypertension, bradycardia, and respiratory variation (Cushing's reflex).
OR
 - ☐ Failure of maximum medical management.
- Evacuation to a neurosurgeon not available within approximately 4 hours.
- Surgeon training and resources are adequate.

Warning



DO NOT perform cranial procedures if:

- Clinical condition and neurologic status stabilize or improve with aggressive medical management.
- Surgeon and resources are not adequate.
- The patient has a post-resuscitation GCS=3 with bilateral fixed and dilated pupils (non-survivable).

Indications



- If faced with a severe TBI without timely neurosurgical support, attempt to consult with the closest neurosurgeon in the chain of patient care.
 - Worldwide neurosurgery available at Walter Reed National Military Medical Center and San Antonio Military Medical Center.
- CT scan is useful for diagnosis, but if not available, clinical examination paramount to localize pathology.

Pre-procedure Checklist



Prior to the procedure follow this checklist:

1. Attempt to establish teleconsultation with neurosurgeon.
2. Make every effort to evacuate to neurosurgeon within 4 hours.
3. Assess indications for craniectomy.
4. Ensure maximum medical management and resuscitation.
5. Ensure surgeon training and facility resources are adequate.
6. Consider intervention based on injury type (closed vs penetrating).

Closed Head Injury Procedures



- Obtain accurate neurological examination.
 - ❑ If no CT, a plain film may help localize fracture.
- Properly position the patient.
 - ❑ Avoid compression of the neck.
 - ❑ Head slightly higher than the chest.
 - ❑ Rotate head 30-40° off midline with side to be operated on highest.
 - ❑ Mark midline of scalp as well as anticipated burr hole and craniotomy incisions prior to draping.

Closed Head Injury Procedures

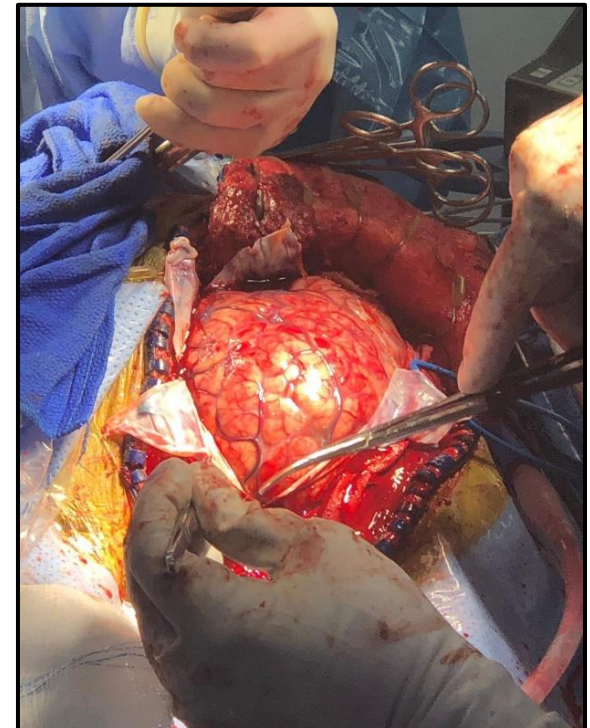


- Burr holes will be made over the frontal, temporal, and parietal convexities using an electric drill in order to identify hematoma.
 - ❑ Dura can be opened through burr hole if hemorrhage is subdural.
 - ❑ If epidural or subdural bleeding or high intracranial pressure encountered, convert to craniectomy.
- Burr holes alone are unlikely to be helpful in the setting of severe TBI.

Closed Head Injury Procedures

For a craniectomy, the dura needs to be separated from the skull and burr holes connected.

- An appropriate craniectomy is usually 15 cm long and 12 cm in height.
- Take care to stay off midline to avoid injury to sagittal sinus.
- If epidural bleeding, evacuate hematoma and cauterize bleeding source.
- If subdural, open the dura, evacuate hematoma and cauterize bleeding source.



Opening the dura after craniectomy

Do's & Don't's



- Do **not** replace the bone.
- Do **not** search for a bleeding source.
- Do **not** close the dura.
- You must close the scalp.
- If the brain herniates rapidly out of the dural opening, close the scalp immediately.

Penetrating Head Injury Procedures

- Exploration without teleconsultation with a neurosurgeon is not recommended.
- Often deep and uncontrollable bleeding may not be readily evident on the cortical surface.
- Exploration below the surface of the brain is not recommended.
- Surgical intervention should be limited to removing bone, opening dura, controlling bleeding, and closing the skin rapidly.



Penetrating head injury

General Procedures



- If cranial contents are herniated from either the entry or exit wound, allow to continue and do not close the wound.
- If evacuation to a higher level of care is not possible, recognize interventions may be futile.

■ Intent (Expected Outcomes)

- ☐ Emergency life-saving cranial procedures will be performed by non-neurosurgeons only when transfer to a neurosurgeon is not possible within a clinically acceptable timeframe.
- ☐ Emergency life-saving cranial procedures will be performed by non-neurosurgeons for patients meeting the recommended clinical indications.
- ☐ Only patients with post-resuscitation GCS ≥ 4 undergo emergency life-saving cranial procedures.
- ☐ Non-neurosurgeons will perform emergency life-saving cranial procedures after teleconsultation with a neurosurgeon.

■ Data Source

- ☐ Patient Record
- ☐ Department of Defense Trauma Registry (DoDTR)
- ☐ ICU flow sheet

■ Performance/Adherence Measures

- ☐ Non-availability of a neurosurgeon or anticipated length of time > 4 hours to arrive at a facility with a neurosurgeon was documented.
- ☐ Teleconsultation with a neurosurgeon prior to craniectomy was documented.
- ☐ The following indications for craniectomy by a non-neurosurgeon were documented:
 - Brain injury with a presenting GCS ≤ 8 AND lateralizing cortical dysfunction (unilateral dilated pupil or hemiparesis) with either:
 - Hemodynamic dysfunction: hypertension, bradycardia, and respiratory variation (Cushing's reflex),
 - OR
 - Failure of maximal critical care management manifested by the occurrence of a new lateralizing cortical finding (hemiparesis, rapidly expanding pupil) and/or further decline in GCS off of sedation.
- ☐ Use of an electric drill for craniectomy procedure was documented.
- ☐ Documented GCS prior to craniectomy at Role 2 was ≥ 4 and ≤ 8 .

References



1. Wester K. Decompressive surgery for “pure” epidural hematomas: Does neurosurgical expertise improve outcome? *Neurosurgery*. 1999;44(3);495-500.
2. Joint Trauma System, Neurosurgery and Severe head Injury Clinical Practice Guideline, 02 Mar 2017. [https://jts.amedd.army.mil/assets/docs/cpgs/JTS_Clinical_Practice_Guidelines_\(CPGs\)/Neurosurgery_Severe_Head_Injury_02_Mar_2017_ID30.pdf](https://jts.amedd.army.mil/assets/docs/cpgs/JTS_Clinical_Practice_Guidelines_(CPGs)/Neurosurgery_Severe_Head_Injury_02_Mar_2017_ID30.pdf)
3. Emergency War Surgery Manual, 4th United States Revision. Office of the Surgeon General, United States Army. Borden Institute. Pp. 20, 233.
4. Rinker CF, McMurry FG, Groeneweg VR, et al. Emergency Craniotomy in a rural Level III trauma center. *J Trauma*. 1998;44(6);984-9.
5. Springer MF, Baker FJ. Cranial burr hole decompression in the emergency department. *Am J Emerg Med*. 1988;6(6);640-6.
6. Gilligan J, Reilly P, Pearce A, Taylor D. Management of acute traumatic intracranial haematoma in rural and remote areas of Australia. *ANZ J Surg*. 2017;87(1-2);80-85.
7. Luck T, Treacy PJ, Mathieson M, et al. Emergency neurosurgery in Darwin: still the generalist surgeons' responsibility. *ANZ J Surg*. 2015;85(9):610-4.

Appendices



- **Appendix A:** Training for Cranial Procedures in Austere Setting
- **Appendix B:** Resources for Cranial Procedures in Austere Setting

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